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**Note on the treatment of Plague with
Yersin-Roux Serum at the Indore
State Plague Hospital and
in the City of Indore.**

During the epidemic of plague of 1906.

BY

Dr. Gopal R. Tambe, M.A. B.Sc. L.M. & S.
State Surgeon, Indore, C.I.

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INTRODUCTION.

The treatment of plague with Curative Serum such as Lustig's or Yersin-Roux's is not a new feature in the history of plague in India. It has been tried in Bombay by Dr. N. H. Choksy at the Maratha Plague Hospital and in his private practice and his report shows that a few other medical practitioners have also given it a trial. Considering the fact that the disease has been raging in Bombay for over 10 years now (and has destroyed human lives ~~to the~~ *by millions* ~~number of more than a lac~~) one would have expected the serum treatment to have become popular if it returned a higher percentage of recoveries than any other drug treatment. It is argued therefore that it has fallen into back ground because it is of little value. It seems to me however that a fair trial it has not been given yet as with the exception of Dr. Choksy and one or two others few medical men seem to have experimented with it. This may be partly due to its cost which is undoubtedly high.

During the epidemics of plague in Indore in 1903 and 1904 I treated a few cases with Yersin-Roux serum with nearly 50% recoveries but the number was so small that it did not supply sufficient material to draw any conclusions from it. When plague again declared itself at Indore this year in the 3rd week of July, I decided upon trying the serum more freely than I had done on previous occasions, both at the state hospital and in private practice. It soon gained popularity which at last led a correspondent of the Pioneer to give publicity to it in the issue of that journal of 7th October 1906. His information was fairly accurate except that he stated that the fever goes down in an hour whereas it takes about 12 hours. Since then I have been asked by a number of medical practitioners to inform them of my results and the technique of the operation.

The following table shows the number of plague cases treated with serum Anti-pestaux at the Indore State Plague Hospital and in private practice.

Name of Operator.	No. of cases treated	Cured.	Died	Under treatment	% of mortality	Remarks.
Plague Hospital Staff	92	53	39		42.3	
Dr. Tambo	61	49	12		19.1	
Dr. S. N. Deo, L.M.S.	4	3	1		25.0	
Dr. Bhandarker, B.A., L.M.S.	1	1	...			
Dr. Atmaram, Asst. Surgeon (Tukojirao Hospital)	5	4	1		20.0	
Dr. Sharangpani, Senior H.A. (Tukojirao Hospital)	19	6	13		68.2	
Mr. Golvelker, Second H.A. (Tukojirao Hospital)	1	1				
Staff of Tukojirao Hospital	7	7				
Mr. Lohokre, H.A. in charge Jail Dispensary	1		1		100.	
Dr. Surjuprasad, Indore (Charitable Hospital)	2	2				
Total...	193	126	67		34.7	

The serum is issued by the Pasteur Institute at Paris in bottles of 20, 40, and 100 c.c. For private cases I think the 20 and 40 c.c., bottles are handy and economical. The larger bottles are suitable for hospital use, as one or more cases may have to be treated at a time. I never had occasion to give 100 c.c. to one case and at one time. Hence in private practice if a large bottle is opened whatever is not used in the required dose to the patient, is wasted, as I consider it unsafe to inject serum except from a freshly opened bottle. I obtained my supply of serum from Messrs. Paranjpe Athaley and Co., and Messrs. Kemp & Co., of Bombay and I can recommend both firms as being prompt and thoroughly reliable.

The injection of serum is given in two ways, subcutaneous and intravenous. Subcutaneous injection is the safer operation and quite enough for most cases, but in very acute cases with high fever and delirium and in advanced cases intravenous method is the better method. But I should not entrust it to untrained hands. Whichever method is adopted, the operation has to be done under strict aseptic precautions.

I usually inject 40 c.c. to start with, and wait for 24 hours to watch the effects of the injection. Reaction is certain, in most cases the temperature begins to come down in about 12 hours; I have known it fall from 105° or 6° to 100° or 99° ; in some cases it even becomes normal. If after 24 hours the temperature continues to be high, or begins to rise after it has once fallen, a second injection equal to the first is again given, and another 24 hours allowed to pass. A third injection is not required unless the symptoms do not abate. In one or two instances I had to give as many as 4 or 5 injections. For children under 10 years I have rarely given more than 20 c.c. at one time. Dr. Choksy in his report recommends 100 c.c. being given with the first injection and another 100 c.c. repeated 6 or 8 hours after, followed by (if necessary) a third injection after a similar interval. For the sake of comparison I quote Dr. Choksy's figures along with mine.

DR. CHOKSY'S.

Series.	No. of Cases.	Average No. of injections per patient.	Average No. of injections per recovered patient.	Average quantity of serum injected per patient.	Average quantity of serum injected per recovered patient.	Mortality per cent.
I (2 injections per day)	102	9	12	590cc	660cc	59.8
II (1 injection	53	5	6	360cc	390cc	58.4
III (do. alternate-system	51	5	6	350cc	360cc	72.5
IV (2 injections	16	9	10	560cc	560cc	56.2
Private cases	106			130cc 550cc	200cc 400cc	43.3

MINE.

No. of injections	No. of patients	Average Quantity of serum injected per patient,	Average per cure.
1	114	35.7cc	42.7cc
2	51	52.0cc	53.1cc
3	24	87.3cc	96.1cc
4	4	112.5cc	112.5cc

The tables show that the quantity of serum injected by Dr. Choksy in each of his cases is nearly 7 to 12 times greater than that used by me and that his dose is also nearly 2 or 3 times larger. In spite of this difference his results are no better than ours.

The treatment with serum can not be expected to give cent
 SELECTION OF CASES. per cent results, nor is it effective in all types and all stages of plague. All observation shows that it is of no avail against pneumonic or septicæmic plague. In plague accompanied with severe diarrhoea and vomiting the chances of recovery are always very slight and serum does not do much in such cases. Fortunately the percentage of these types is small in an epidemic. Nearly 85 to 90% of cases are of the bubonic type, and it is they who are benefited by the curative serum.

Another point that I must emphasise is that the serum gives the best results if given within the first 24 hours of the attack, the sooner it is given the better. Hence the time of attack should be carefully ascertained before an injection is given. It will be seen from the following table that after 24 hours the serum does not produce much effect. With the object of collecting experience, I have tried the serum in all types and in all conditions, without looking to the results or to the cost. I have now come to the conclusion that only bubonic cases taken early derive benefit from serum and that it is useless to treat moribund cases with it.

Dr. Choksy has mentioned in his report that he adopted the method of "rational alternation". In treating his cases with serum with a view to ascertain the comparative value of the

treatment. He rejected the unfit cases first and in the remainder he treated every alternate case with the serum, so that those left untreated would be the controls for purposes of comparison. I do not see the necessity for this. In a city like Indore *(Pop 86000)* where the daily mortality remained stationary at 100 continuously for three weeks in spite of the fact that two-thirds of the population had left the town, the ratio of recoveries to attacks should itself serve as a control. The natural percentage of recoveries is usually not more than 15 to 20 per cent, including the number of recoveries from pestis-minor which occur at the end of an epidemic. In Indore a higher per centage of recoveries this year was realised apart from the serum treatment, because of the alacrity with which the public availed themselves of the medical aid which the policy of the Durbar, supported by the devotion of the medical and Municipal staffs placed gratis at their disposal even in their own homes. The recoveries amongst general patients in the city, not to mention those treated at the plague hospital or registered as out-patients in the city hospital were not less than 1550 out of between 6000 to 7000 attacks.

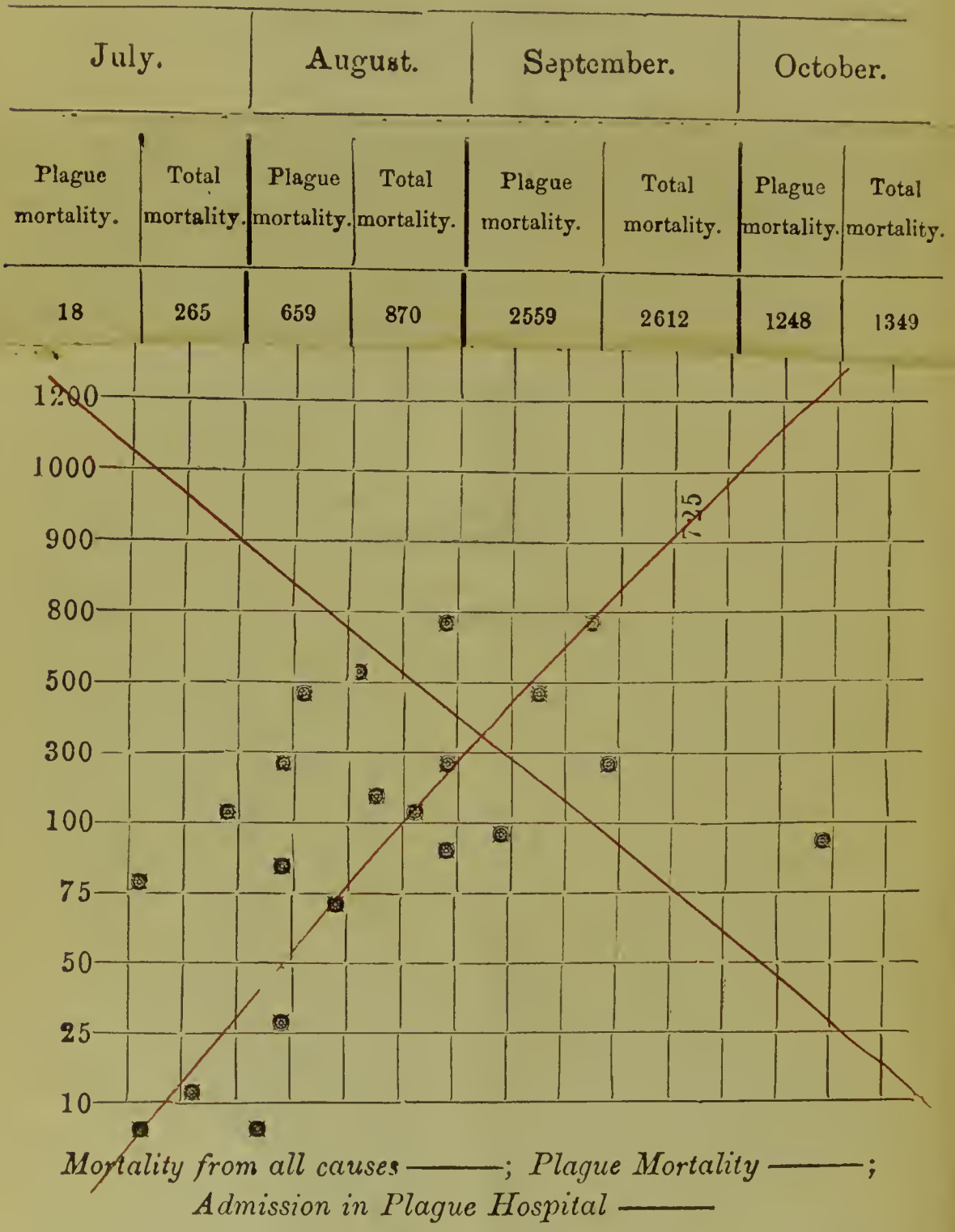
The results of cases treated at the plague hospital without serum were as follows :—

Duration of attack before admission.	No.	Cures.	Deaths.	P. C. Mortality.
1st day	61	30	31	50.9
2nd day	60	23	37	61.7
3rd day	58	17	41	70.7
4th day	81	21	60	74.1
5th day	23	9	14	60.9
6th day	107	52	55	51.5
Total	390	152	238	61.1

Comparing these figures with the table below it will be seen that the gain in recoveries from serum treatment over those from the nonserum treatment is 27% thus.

Cases.	No.	Recoveries.	Deaths.	P. C. Mortality.
Non-serum	390	152	238	61.1
Serum	193	126	67	34.7

To show that the virulence of the epidemic was not exhausted when the serum treatment was adopted, I append a diagram of the monthly mortality in July, August, September and October, which cover the plague season of Indore.



The lowest curve represents the admissions of plague cases in the Plague Hospital. The following statement shows the number of injections we did in these months. It is evident from

these tables that during the months of August, September, and the first week in October, the mortality was continuously going up and it was in these months that most of the curative injections were given.

Months.	No. of Injections.
July	Nil
August	6
September	122
October	65
	<hr/>
	Total 193

I shall now proceed to discuss the immediate and after effects of the curative serum, the influence which racial or constitutional differences exert on the treatment, the difference in the results of cases treated in the hospital and at the patient's home, and lastly the question when is the serum most effective. Among the graver complications of plague are pneumonia, diarrhoea, hoematemesis, hematuria, marasmus, dementia, vocal paralysis, loss of speech, some times permanent, corneal ulcers leading to sloughing of the whole eyeball etc. Every one excepting the last three is met with in a small proportion in cases treated with serum even from the first day. The question is whether they follow the treatment as its consequence or there is already the predisposition to them and the serum is not able to counteract them. I am inclined to take the latter view, because of the smaller per centage of each of the above mentioned complications and the total absence of the last four in serum cases than in those treated otherwise. Most of these complications are to be met with in cases whose onset is marked with very high fever such as 105° , 106° or even more from the very beginning. The high temperature itself is responsible for all the varieties of hoemorrhages following congestion of the different viscera in the body.

The following statement shows the comparative results of serum cases treated at home and in the hospital.

	No. treated.	Cured.	Died.	P. C. Mortality.
Hospital cases	92	53	39	42.3
Cases treated at home	101	73	28	27.7

From my experience in Indore I find that the people in C.I. are very averse to going to the hospital and remaining there as inpatients. This is true of all classes and for all diseases. So far as males are concerned, a small per centage of patients may be found to be willing to go to the hospital, but the per centage of female attendance in the hospital is still smaller. This is because of the purda-system only. Purda women prefer to die at home unattended and what is more unfortunate is that the husbands prefer to let them die rather than allow them to attend a hospital. Ignorance and want of education in general account for this. With a view to give medical relief to the purda plague cases I started a house-to-house enquiry of fresh attacks; the report of the usefulness of the serum had already reached even the women in all classes and when they saw that the remedy was being applied in their own home, without any charge, numbers of applications for injections daily came in. Fortunately amongst the Mahomedan families especially, the serum found great favor and won for us their confidence. Every serum case was regularly seen every morning, sometimes twice a day until it recovered or succumbed. In cases of extreme poverty, the state medical staff paid out of their own pockets for milk and nourishment. The reward of all this care and trouble was obtained by saving 16 per cent more lives over the plague hospital results. I may note here that the houses of our patients were by no means clean and airy. They were exactly what they ought not to be. Nourishment in all poor cases was limited to milk and sago. My explanation for the higher percentage of recoveries is the absolute rest and continuous attendance received by patients treated in their houses. Here I may be allowed to remark that compulsory removal to hospital after second day is often risky. The heart is so weak that even suddenly sitting up is followed by heart-failure and death. In a hospital it is not possible to provide a nurse or an attendant for each case separately, whereas at home this is the rule.

<p>IMMEDIATE AND AFTER EFFECTS OF CURATIVE SERUM.</p>	<p>The immediate effect of the Curative Serum is the fall in temperature and with it the improvement in the pulse, or in other words, the improvement in the condition of the heart. I have heard it said that immediately after the injection of the serum the temperature goes up instead of going</p>
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down. This is supposed to be due to the reaction of the serum. I believe the inference is not correct. Curative serum has not this effect of quickly lowering the temperature like phenacetin and antipyrin. It takes nearly 6 to 12 hours to act. During this time if the temperature went up after the injection I should consider it to be the result of the toxin of the disease, rather than that of the serum. If after the first 12 hours have lapsed, the temperature continues to be high, a second injection is indicated. Before there is a perceptible fall in the temperature, the head-ache which is very intense in plague is relieved considerably and some-times it completely disappears. The pain in the bubo subsides likewise. The patient looks brighter and feels greater improvement, in his condition. Delirium which is noticed in a large percentage of cases rarely sets in, and the brain remains clear. Convalescence rapidly sets in and is never prolonged as in non-serum cases. It has been remarked by other observers that there is lesser suppuration of buboes. My experience is otherwise. I have had quite a number of cases in which the buboes did suppurate.

Amongst the after effects of the serum joint pains and urticaria were most prominent. Joint pains

AFTER EFFECTS OF THE SERUM. occurred in about 5% cases. In one case, almost every joint in the order of upper extremities neck and lower extremities became painfull and the part swollen. I never had a single case of an abscess in any of the 193 cases treated with serum. In one case only (at the plague hospital) signs of tetanus were noticed on the 3rd day after the 3rd injection given in the hospital. The 1st 2 injections were given at home by myself. The Hospital Assistant on duty as soon as he noticed, this dangerous complication, at once gave an injection of antitetanic serum and put the patient on Bromides with the result that complete recovery followed though the convalescence was prolonged. The joint pains were relieved with a smart purge and a few doses of soda-salicylas.

The following statement compares the results of treatment in hospital and private practice in the different races,

INFLUENCE OF RACIAL DIFFERENCES.

	Hospital patients				Private practice			
	No.	Died	Cured	P.C. Mortality	No.	Died	Cured	P.C. mortality
Hindus	79	33	46	41.7	53	19	39	35.8
Mahomedans	13	6	7	46.1	43	9	34	20.9
Parsees	...	...	nil	...	3	...	3	...
Europeans	...	...	nil	...	1	...	1	...
Goanese	...	...	nil	...	1	...	1	...
Total	92	39	53	42.4	101	28	73	27.7

The percentage of mortality in each class is higher in the hospital than in private practice. I have already explained the cause for this difference in the two cases (on page 8). Looking at the question from the point of view of racial influence the mortality amongst the Mahomedans is lower than amongst the Hindus. It is in the ratio of 5 Mahomedans to 8 Hindus. I do not think there is much difference in the general condition and surroundings of both Hindus and Mahomedans at Indore. The difference which is so well marked appears in my opinion to be purely constitutional. The Mahomedan has a stronger stamina than the Hindu and perhaps it may be due to the difference in the nature of diet of the two communities.

My experience on this point agrees with the experience of Dr. Choksy and other workers in this line. **WHEN IS THE SERUM MOST EFFECTIVE.** Whatever the treatment adopted, it is a matter of common sense, that the sooner it is commenced the better are the results obtained. This is more true especially in the cases of serum treatment. It will be apparent from the following statement that the earlier the serum is given the greater the chances of recovery.

Cases Injected with serum on	Hospital cases				Private Cases			
	No.	Cured	Died	P. C. mortality	No.	Cured	Died	P. C. mortality
1st day of attack	41	28	13	31·7	83	62	21	25·3
2nd day of attack	30	15	15	50·	9	8	1	11·1
3rd day of attack	15	9	6	40·	6	3	3	50·0
4th day of attack	4	1	3	75·	2	0	2	100·
5th day of attack	2	...	2	100·	1	0	1	100·
Total	92	53	39	42	101	73	28	27·7

Hence as far as possible as soon as the first symptoms of plague manifest themselves, the nearest Doctor should be sent for and he should be asked to give injection of the serum. In the case of no other disease delay is so dangerous as it is in the case of plague. The damage that follows is out of all proportion to the time lost. Granting that it is often difficult to diagnose for certain whether a particular fever case is of plague or not so long as it is certain that the curative serum is harmless there is nothing lost in giving an injection of 40 c. c. as soon as the fever or bubo appears. If the diagnosis is incorrect the mistake is on the safer side. The fever goes down, headache disappears, and the bubo becomes less painful. There is comparatively very little exhaustion, and the patient stands a fair chance of recovery. The best time for the serum treatment is within the first 24 hours of the attack. 24 hours is a fairly wide limit as it removes all possible inconveniences to the patient as well as to the doctor. After 48 hours have passed away it is no use giving serum treatment at all.

This is a very dangerous complication in plague. It occurs both amongst those treated with serum and those treated without it. I think it is comparatively less in cases treated with serum. I believe no better description of this condition could be given than that given by Dr. Choksy in his report. It runs thus "plague marasmus occurs in two forms, the acute and the sub-acute. It shows itself about the time the patient is getting apparently better, about the 8th or 10th day. Considerable improvement in his

general condition, the pulse and temperature almost normal, the bubo either small, hard and getting gradually absorbed or just suppurating; and the body free from living plague germs, are the antecedent conditions. In the course of a day or so, or, even during a single night, a sudden change is noticeable in the patient. The face becomes pinched and hollowed out from rapid wasting and shrinkage of the adipose and muscular tissues; the bones and prominences start out from the face; the eye-balls sink, the look becomes vacant and he lapses into a condition of semi-stupor, from which he can be roused with difficulty. Speech becomes inaudible, and reduced to a whisper; the patient moans occasionally and does not like to be disturbed. The decubitus is dorsal. The pulse, a few hours before so hopeful, becomes theady, and the extremities cold. There is a great prostration and general heavy condition of the limbs, which become almost leaden, and paresis of the muscles of deglutition may supervene making feeding difficult. Simultaneously with the above symptoms, the body becomes intensely icteric. The conjunctiva and nails become yellow. The skin of the same hue and all the excretions highly charged with bile. There is not much rise of temperature at first unless there exists at the same time some secondary infection or deep suppuration. The patient remains in this condition for a day or two and then the stupor becomes intensified, the pulse weaker and weaker, the wasting increasing considerably till the extremities and trunk are involved. The reflexes are abolished; glosso-labiopharyngeal paralysis sets in and so also polyneuritis, if life is prolonged. The cornea becomes glazed, and either keratitis or panophthalmitis result. The decubitus may now become lateral with the knees drawn up, and the legs flexed over them. The temperature steadily rises and when death supervenes within 6 to 8 days from the onset of the above symptoms, it may be as high as 106° - 107° . All these symptoms indicate profound intoxication of the system." My experience of cases of plague marasmus is very limited and I can not hazard any remarks on it. I can only say that in none of my cases did icterus set in.

Here I can not too strongly impress on the mind of my readers that the treatment of plague with the curative serum, does not altogether do away with medicinal treatment. Like every other

MEDICAL TREATMENT.

line of treatment, it requires to be supported with stimulants and tonics, such as strychnine, quinine in small doses, digitalis, alcohol (in some shape) careful nursing and absolute rest. In cases with violent delirium, I think it is not safe to give morphea either internally or subcutaneous. I have never given it myself nor did I allow my assistants to do it. I always prescribed Ammonium bromide for such cases. I should like to invite the attention of my readers to the effects of opium in plague, described in Indian Medical Gazette by Dr. Choksy. In high fever, ice or wet pack on the head was used. Phenacetin, antipyrin, and there-likes should never be used to bring down the fever as most of them do it at the risk of the failure of the heart.

CONCLUSION.

I have placed before my readers, the results of treatment of plague with "SERUM ANTIPESTEUX" otherwise known as the "YERSIN'S ROUX" serum. It will be seen from the foregoing observations that this serum treatment is a more successful remedy than any other yet discovered; I have mentioned above that it is mostly serviceable in bubonic cases. It does not much affect the other types; it has to be given within the first 24 hours of the attacks. If a case is to be sent to the hospital, the sooner it is removed the better after injecting it at home, as with the progress of the disease, the heart becomes very weak and the patient becomes unfit for removal. Wherever the patient is treated, either at the hospital or at his house, he requires the best attention and care in nursing and medication and absolute rest. In the case of a hospital these things can not be secured unless there is a sufficiently large staff of well-paid medical men and other servants, and unless the institution is liberally maintained. One man can not do the work of a ward-boy, a lampman, water bearer, and a sweeper, without risk to the lives of the patients. Each patient requires a special attendant for all the 24 hours and throughout the whole course of his illness. A patient at his house can command all these things and can combine them with the serum treatment. This is the whole secret of why the percentage of recoveries in private practice is very much higher than in the hospital,

I can not conclude this note without expressing my sincere

thanks to Mr. O. V. Bosanquet, I. C. S. Resident at Indore and to the Durbar for their liberality in giving me the necessary funds and encouragement. My sincere thanks are due to my friend Dr. Deo Superintendent Indore Municipality and his staff and my subordinate staff who have this year shown exemplary zeal and who freely at all hours gave their services to all persons rich or poor of all classes of society.

Indore,
Tukojirao Hospital
24th Dec., 1906.

GOPAL R. TAMBE,
State Surgeon
Indore.



